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# Understanding Mechanotransduction Through Mathematics

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# **Understanding Mechanotransduction Through Mathematics**

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Mechanotransduction is the mechanism by which mechanical forces cause the heart to remodel. In our mathematical model, the mechanical bidomain model, the intracellular and extracellular spaces are coupled by integrin proteins in the cell membrane. We obtain a set of coupled partial differential equations describing the displacement and pressure in the intracellular and extracellular spaces. In our preliminary studies, we analyzed small samples of tissue with simple geometries, for which the model equations were solved analytically. In the heart, cardiac muscle fibers curve, creating zones of membrane forces resulting in regions of mechanotransduction. In this study, we use the finite difference method to solve the bidomain equations numerically, with different fiber geometries. We also check the accuracy of our algorithm by performing a series of calculations. We consider the magnitude of the active tension  $T$  is constant but its direction makes some angle with the  $x$ -axis. The difference in the intracellular and extracellular displacements result from the “bidomain” behavior of the tissue which gives rise to forces on the integrin proteins in the membrane. The fundamental hypothesis is that this membrane force drives mechanotransduction. Our long-term goal is to use the mechanical bidomain model to suggest experiments and make predictions about remodeling in the heart.